MOLLUSCA-PERIODS IN THE SEDIMENTS OF THE HUNGARIAN PLEISTOCENE

by

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Introduction

The Pleistocene, the geological period immediately preceding the present time, had a great effect on the Earth and on its life. It formed the surface with denudation and with accumulation of sediments. The periodicity of its climate is not only a climatological problem but also an astronomical one, because these periods are calculated according to the laws of the attraction of the planets too. The Pleistocene influenced essentially the distribution of plants and animals. Appearence of the man and its prehistory occurred also in the Pleistocene.

The tasks of the Pleistocene-research are manysided. They can be solved only through the collective work of various sciences. The literature on the subject is extremly large. The results attained till now are summarized in books and are discussed on international congresses. The unsolved and disputed problems form still an entangled profusion and this enlarges further with the broadening of researches. According to this situation the Pleistocene researches are in progress with continually increased rate.

In Hungary the periglaciale sediments of the Pleistocene are settled with a special abundance. Investigation of these is an important and from the point of view of the international Pleistocene-research a highly responsible task of the Hungarian research workers. In our country the research workers of the Pleistocene work intesively on the line of geology, palynology, mammology and astronomy since the end of the Second World War. Author joined to this complex work with the investigation of *Mollusca*-residues in 1950. During the preceding 20 years author was occupied in the investigation of the distribution and life of the recent Hungarian *Mollusca* fauna. These investigations of the author are continued at present too. Material derived from superficial courses of outcrop was several times investigated by the author before, but only as the starting point of the recent fauna. The Hungarian Pleistocene has only residues belonging to recent species, therefore it was not necessary for the author to become acquainted with new species, at the same time in the evaluation of the Pleistocene fauna he could make good use of his experiences relating to the life of recent exemplares. It is undeniable, however, that the investigation of the material from the Pleistocene put the well known mode of life of certain in a new and interesting light. Study of the circumstances of life of fossile exemplares may be a good lesson for the researcher of the recent fauna too. Results obtained till now by the author on the Pleistocene fauna will be published here on the basis of his experiences obtained on the recent animals. Author made an effort to produce results interesting not only for malacologists but profitable also for scientists in other branches of the Pleistocene-research on international level too.

Earlier results of investigations of the Mollusca of the Hungarian Pleistocene

Numerous papers are already published by other authors about fossile *Mollusca* of the Hungarian Pleistocene sediments. In these works many species were enumerated and their identity with recent species were demonstrated. The enumerations contained many detailed and valuable data about distribution and great differences were demonstrated between the former and recent area of the species. Generally, the number of the thermophil elements was then much smaller and the oligotherm elements were considerable more wide-spread than today. From the loess of the Hungarian Plain species were demonstrated which live today only on highlands. These deviations were explained by the climate of the Pleistocene which was colder than nowadays. On the basis of the data accumulated and on the knowledge of the mode of life of the species found several facies (aquatic, terrestrial, locale and abyssic) were established. These works remained, however, in contrast to all of their value only descriptive and mere publication of data and investigate only material of superficial courses of outcrop.

In Hungary many artesian wells were already bored but, serving only practical purposes, their bore plugs were not suitable for scientific work. The changes of the *Mollusca* fauna according to depth were interpreted as facies changes of a similar climate because only species known also from the superficial courses of outcrop were demonstrated. From the works of former scientists the results of T. KORMOS and M. ROTARIDES are to be distiguished. KORMOS was still the follower of the today outworn monoglaciale conception and he believed this supported by the data about Pleistocene *Mollusca* known by him. ROTARIDES considered in 1942 the Hungarian Pleistocene indivisible on the basis of *Mollusca* residues although he dealt much with the *Mollusca* of the Pleistocene and was well up in the results attained up to that time. The *Mollusca*-fauna was considered unfit for levelling of the Pleistocene due to the lacking of level-indicating species. From the sediments of times before Pleistocene much extincted species are known which lived only in a definite geological epoch and therefore they indicate by their mere presence the geological age of the sediment. Our Pleistocene *Mollusca* species are still alive. Its presence itself is therefore not characteristic on single parts of Pleistocene. After all our old literature about *Mollusca* separated the Pleistocene from Pliocene and Holocene, established within facies-changes but did not distribute it into *Mollusca*-periods.

Mollusca from the borings between Duna and Tisza in 1950

Author began to deal with Pleistocenous *Mollusca* in 1950, when he was requested by professor I. MIHÁLTZ to evaluate the *Mollusca* fauna of 40, 30 m deep borings. These borings were performed on behalf of the Hungarian Geological Institute and directed by MIHÁLTZ. The borings were setteled on a 140 km long profile in the direction of North-East and South-West from the Danube to the Tisza, more exactly from Szentes to Baja. The aim of these borings was the scientific knowledge of the sediments of the Hun-

garian Plain and they are performed with the corresponding technics. Many thousands of *Mollusca*-shells were found in these borings and to evaluate this material from the point of view of determination and division of the sediments was author's task.

Because former scientists did not perform such kind of work, new methods were to be elaborated. According to author's fundamental idea if there were periodical changes in the climate of the Pleistocene, corresponding to these changes, the Pleistocene fauna must show periodic changes too. Without any doubt, this periodicity showed in all group of animals from the *Protozoa* to the Mammals. But while in contrast to the other animals the *Mollusca*-shells were fossilized in large numbers and sufficiently consistent, with the aid of them the climate-periods of the Pleistocene may be reconstructed. Lacking level-indicator species reconstruction may be based only on the analysis of the *Mollusca*-coenoses. Qualitative and quantitative distribution of the species in the recent coenoses may be reasoned by the environmental factors of the biotop. *Mollusca* are very sensitive to the factors of their small environment. During investigation of recent populations the same species were observed in different biotops but the significance of the species in the associations was different according to the environmental factors. In the evaluation of the *Mollusca*-populations of the Pleistocene the same method was followed which in the investigation of the recent populations was already successful applied. In the case of a recent material both the coenoses and the environment are given. In the case of a material from the Pleistocene only the coenoses are known and from these must conclude to the former environment. During the work it were to be distinguished the facies changes showing the periodicity of the macroclimate from the facies-changes of locale characteristic. We will come back to these interesting and complicated problems later, when statements will be supported with abundant data from the investigations. These two different sorts of the facies-changes were not perceived by former investigators due to the lacking of material collected with sufficient regularity. MIHÁLTZ collected with great caution, distinction the kind of facies on the rich and geologically precisely levelled material was not hard. Changes attributed to the changes of the macro-climate occurred repeatedly on several places and to a considerable thickness and they were accordance with the geological level of the profile. During evaluation, it was made an effort to utilize entirely the knowledge relating to the mode of life of the species occurred. It was taken into consideration their recent area according to geographical width and height above sea level, their demand on temperature, humidity and vegetation, the data relating to optimum, pejus and pessimum of each factors. Author was greatly supported by his more than two decennial experiences obtained by investigations of *Mollusca* in different environments.

This evaluation is already published* elsewhere here only a short summary is given. Species living in running water (*Theodoxus transversalis* C. PF., *Lithoglyphus naticoides* C. PF., *Unio crassus Retz.*, *Sphaerium rivicola* LM., *Sphaerium solidum* NORM.) were found only in the borings near the Danube and Tisza. Therefore it may be supposed that in the time of the

* HORVÁTH, A.—ANTALFI, S.: Malakologische Studie über die oberen Pleistozän-Schichten im Süden zwischen Donau—Theiss. Ann. Biol. Univ. Hung. Tom. II. Budapest 1952. p. 417—428. Hungarian with German summary.

formation of the sediments the two rivers ran roughly on their present place. The many thousands *Mollusca*-shells found on the other places of the profile were the residues of still-water and terrestrial species. The characteristics of a river-sediment i.e. the joint occurrence of species living on different places and the differentiation of shells according to weight was not observed on this fauna. The hypothesis persisting till now according which to the sediments between the Danube and Tisza are the sediments of the Danube going towards the present bed is incompatible with the *Mollsuca*-fauna found in the profile. This *Mollusca*-fauna proves MIHÁLTZ's statement, who considers these sediments as aeolic ones. MIHÁLTZ evaluating the profile from the point of view of geology distinguish 6 aeolic loess layers.* Before, it was known only one loess layer on the Hungarian Plain, the uppermost and the lower loess layers were considered as aquatic sediments. The sixth loess layer — in the absence of *Mollusca*-residues — was not evaluated. The fauna of all other loess layers consists of terrestric species and therefore they must be considered as aeolic sediments. The parts of loesses containing limnetic species apparently are blown into still-waters. The *Mollusca*-associations of the loesses are considerable different from the recent *Mollusca*-associations of the Hungarian Plain. In the recent *Mollusca*-fauna thermophil species are dominant while in the loesses they played a subordinate role. The bulk of the loessfauna consists of oligotherm ubiquitous species which live now in our country rather in the highlands-biotops. There were found also species which live nowadays exclusively in mountains. These data show an glaciale climate colder than that of today. The detailed fauna-analysis demonstrated climatic differences between the individual loesses. The rich fauna of the three upper loess layers similar to each other proved a relatively mild glaciale climate. The climate of the uppermost layer was the most mild. The climate of the second layer was colder while that of the third much more colder than the former two. The forth and fifth layer were very similar to each other. They had a much more poor fauna due to a considerably arider and colder climate. The forth layer had a little milder climate.

Between the forth and fifth loess layers was a clay-layer, the other loess-layers were separated by running sand. The climate of the sand layers was considerable colder and arider than that of the loess layers. The fauna of the clay-layer between the forth and fifth loesses and below the loess layers show a climate with glaciale character and humider and milder than that of the loesses.

Investigations on the loess-wall of Paks

After the investigation of the material from the borings in 1950 author was requested by the geologist P. KRIVÁN to investigate the soil samples from the loess-wall of Paks. These samples were collected from the loess-wall of 43,40 m height from every 20 cm-s continually and repeatedly. KRIVÁN attached an outline of the profil too on which alternate loess and clay layers and a running sand layer were represented. All snails of all samples were consi-

* MIHÁLTZ, I.: La division des sédiments quaternaires de l'Alföld Acta Geologica. Tom. II. Fasc. 1—2. Budapest 1953. p. 109—120.

dered during evaluation. The uppermost 9,50 m thick loess layer designed homologcus by KRIVÁN was differentiated into five layers with the aid of snails. The five glaciale periods demonstrated had a climate much arider and colder than today. Relatively most humide and most mild was the middle layer, the most cold and most aride was the uppermost and the most lower. These results showed great novelty in contrast to author's previous experiences. The loess layers from the material of borings in 1950 seemed to be the sediments of different glaciale periods in which in the middle an aride and cold maximum and in its beginning and its end milder and humider climate was found. The five-periodic loess of Paks shows the contrary of this natural climate-change. It seemed that this loess is the sediment of two glaciale periods, between them the aride and cold character of the climate did not cease only lessened, so they are fused to a certain extent. For interpretation of this phenomenon the climate-curve of MILANKOVICH and BACSÁK was also employed. This curve shows the astronomically calculated climate-periods of the Pleistocene. Author was able to identify his snail-periods with the part of the climate period designing the glaciales Würm 3 and Würm 2 and the three interstadiales between them. On author's reconstruction the fluctuations of climate were entirely corresponding to BACSÁK's hypothesis. Such a measure of agreement may not be accidental, further on the astronomical calculations of the climate periodes were believed to be true. Naturally, these periods were tryed to follow during author's subsequent work. Unfortunatelly, the fauna of the lower layers was very poor, also sediments without snails were found. In spite of this through the hole Pleistocene succeded to follow the parts of the climate curve during which BACSÁK supposed the inland ice carapace on the area of the Scandinave glaciation. The effect of the ice-free periods was not manifested on the fauna therefore no sediments were formed during these periods.

The results of investigations of the loess wall of Paks were already published,* therefore they are outlined here only shortly. The same profile was very detailed elaborated by KRIVÁN from the point of view of geology, he gave also different diagrams.** His reconstructions about the periodic changes of environmental factors correspond generally with them of the author, moreover his time-scale in the upper and middle Pleistocene until the end of Riss 1 agree exactly.

The boring of Felsőszentiván and methods of its investigation

For further study of Pleistocene sediments of the Hungarian Plain MIHÁLTZ settled a new boring in Felsőszentiván in 1954 along the profile of 1950 mentioned above. Felsőszentiván is situated about 20 km eastward of Baja. The boring is 77 m deep, the samples were taken generally at 20 cm intervals (sometimes samples of other measures e.g. 10, 30, 40, and 50 cm-s were also taken.) Diameter of the drill pipe till 29,60 m was 13,5 cm, below 9,5 cm. Accordingly, the volume of the measures of the 20 cm long samples

* HORVÁTH, A.: The snails of the pleistocene deposits at Paks. Állattani Közlemények, Budapest 1954 p. 171—188. Hungarian with English summary.

** KRIVÁN, P.: La division climatologique du pléistocéne en Europe centrale. Ann. Inst. Géol. Hung. Budapest 1955. p. 441—510.

were till 29,60 m 2861 cm^3 below 1417 cm^3. The geological profile of the boring was minutely elaborated by MIHÁLTZ. On the profile alternative layers of loess, clay and sand are shown. He give also full details of the transitions.

From the samples all *Mollusca* residues were washed out on the spot and separately packed. The first task of the investigation was the determination of the species and the number of exemplares. Conservation of the residues was generally good, unbroken or scarcely damaged shells were also found. But for determination of the exact number of exemplares the fragments were also to be taken into consideration. Determination of the fragments was sometimes a hard task, but by a scientist in possession of experiences of many years with the investigation of microscopic fine-morphological details and with the aid of comparative material could be solved. The determination of the number of exemplares, however, remained problematic. Counting of the fragments one by one would give a false result because the separate pieces of the same exemplare would regarded as separate individuals. Therefore only one kind of part of the shell (apex, the navel or thickening of the aperture respectively) were counted. The work was facilitated that one part of the shell may be better conserved than the others. In case of need two kind of parts of shell the same species were separately counted and in such a case the higher number was noted. According to estimation the amount of the uncounted fragments was not larger that would be needed for completion of the counted fragments. If only a few fragments were available, they were compared cerefully the nuances, the worning and other small deviations under the microscope and so were determined wether to how much individuals they could belong. The juvenile and adult exemplares were counted together. Otherwise the transitions and the arrangement of apices and other parts of the shells would present insoluble problems. Naturally, individuals of different ages were found. In rich samples occurred generally many juvenile and adulte individuals and inversely. The measure of the samples was reletively small and therefore adulte exemplares of species of greater sizes *(Fruticicola fruticum, Arianta arbustorum)* occurred in them in considerable amount only in form of fragments. For the most part juvenile exemplares of these species were found.

From the boring on the hole 104 379 individuals of 61 species were counted. This work demanded three years counting 3—4 working hours daily. Periodic changes of the *Mollusca*-fauna became visible reviewed the data (estimating the frequency with the aid of a 1—5 scale) of the samples following each other. This method was succesful applied for the evaluation of the material from the borings of 1950. Counting of the individuals in the profile of Paks was necessary and also easy to the small number of them (1055 exemplares in all). Exact counting of the individuals in the material of the boring of Felsőszentiván was absolutely necessary because 1. the material was obtained from a boring which was performed with special care and with great investation for obtaining fundamental scientific informations. 2. This paper deals with important problems not yet cleared up and therefore it was to report with unmistakable precisity the data on which the conclusions were based.

For exposition of the qualitative and quantitative distribution of the material according to borings and depth a Table and 2 Figures were construc-

ted. In the Table the absolute numbers of the individuals of the species are shown. The species are distributed into 6 ecological groups according to their mode of life. Inside the single groups the species are taxonomically arranged. Figure 1 represents the numbers of individuals arranged according to the boring samples and ecological groups. The scale is logarithmic because of the great variance in the number of individuals in the different periods. The data represented in the Table were here and there somewhat modified in interest of proportion. Because the volume of the boring samples was till 29,60 m 2861 cm^3 and lower 1417 cm^3 the numbers of individuals of the upper samples were divided with 1,5. The data of samples not 20 cm long were proportioned to the 20 cm long samples e.g. in the case of 10 long samples the number of individuals found were multiplied with 2, in the case of 30 cm long samples with 2/3 etc. Logarithm of 1 is 0. Therefore from the Figures all ecological groups represented in a sample with only one individual were omitted. This fact would influence in some places and to some extent the evaluation if it would be based only on the Figure without the Table. This reduction makes incomplete the series somwhere supplemented with single individuals, moreover it makes disappear a hole series arising from repetition of single individuals. All these do not disturb, however, the general inquiry which the Figure want give for the readers.

Figure 2 was made from the data of the Table. It shows the percentile distribution of individuals among the ecological groups in each boring samples. Comparing the groups with each other, changes of the ecological character of the fauna may be reviewed.

To the data of the Table and of the Figures will be reverted later and their details will be explained if it will be necessary. Several times were mentioned the ecological groups indicated in the Table and Figures among which the species were distributed to facilitate the evaluation. During evaluation always will be refer to these groups and it is desirable to make ourselves acquainted with them.

Ecological groups and the species of the Mollusca in the material from the boring of Felsőszentiván

The 61 *Mollusca* species found in the boring live also today and with the exception of *Vallonia tenuilabris* they live also today in the fauna district of the Middle-Danube, moreover inside the Hungarian borders too. The *Mollusca*-periods of the profile are not characterized by separate faunae but by the periodical changes of the same fauna. The existence of these changes are seen from the Table and the Figures without any explanation. The cause of the changes is the reaction of the fauna to the changes of the environment. If the environment changes in favourable direction from the point of view of the *Mollusca*-life, the fauna became richer, otherwise poorer. Factors of environment cannot be favourable for all species, because the demands of the species are different. The number of individuals of a species is generally in direct proportion to the favourity of the environmental factors. Changes in the environment cause therefore changes in different measure and direction in the number of the individuals of the different species. While the number

of individuals of one species rises, that of the others may diminish. The measure of changes also differs by the individual species according to their special demands. Changes in the *Mollusca* material from the borings are the result of the processes outlined above. It follows from these that knowing the demands of the species for the environment, from the changes of the fauna the changes of the environment may be reconstructed. If the environmental changes exert an influence on different species simultaneously on the same place, they react with rise or diminishing of the number of individuals according to their special manner. So the data of the individual species support each other in the work of evaluation. The demands of the 61 *Mollusca* species found in the profile are strictly speaking 61 different demands because no complete agreement exists. The situation is entirely other when not for identity but only for similarity are searched. On the basis of similarity the fauna may be distributed into groups. Raising of such groups was necessary for successful work. Construction of the Table with mere taxonomical arrangement of the species the same phenomenon would to be follow with attention on several places of the Table. The aquatic fauna e.g. would be present oneself on three different places, the snails on the top of the Table while the cockles on the bottom. Distribution into groups was required also by the construction of the Figures. Establishing the demand for temperature was based on the climate of the place of boring (the Hungarian Plain). The present climate of the Hungarian Plain is warm compared to that of the Pleistocene. The species loving this temperature were considered as thermophil while species demanding a colder climate were considered as oligotherm. The ecological groups and the species are arranged as follows.

Species of still-water

Their vital condition is water, their presence indicate water. They prefer still-water. If they occur in rivers, the environment is usually similar to that of the still-water. No species was found in the boring which would indicate running water and for the favour of simplicity the species of this group will be mentioned as aquatic species. Aquatic faunae in the Pleistocene indicate humide periods and these indicate a humide climate. The temperature of the humide climate was undoubtedly milder than that of the aride and cold periods of the glaciales. But the humide climate might be could and humide or warm and humide. Which of them was in reality, it was to be determined from the temperature-demand of the species. Analysis of the mode of life of the species reveals also other data about the waters.

Ecological characteristics of the species arranged in taxonomical order are the followings.

Viviparus viviparus L. is distributed in the greater part of Europe from the northern parts of South-Europe and Transcaucasia to the 62° of north latitude in East-Europe. It lives on the lowlands and hills, in mountains it is found only rarely. It occurs in clear backwaters and other stillwaters rich in oxygen and vegetation. In the suitable places of the Hungarian Plain it lives now under optimate conditions. In the Pleistocene it is rare. It is a thermophil species, although it tolerate cold sufficiently.

Valvata cristata O. F. MÜLLER. Its homeland is Europe and North-Asie, from the northern part of South-Europe to the 65° of north latitude in Finland and from the British Islands to Kamchatka. It lives mostly on lowlands and hills, in the mountains, highlands it is rare but in the Alpes it reaches up 1660 m. It lives on the plants in greater and smaller clear still-waters with abundant vegetation. It is known since the Upper-Pliocene. It is frequent in the loess. It is eurythermic.

Valvata pulchella STUDER. It occurs sporadically in Middle- and North-Europe and in the greater part of East-Europe. It reaches to nearly the most northern parts of Scandinavia and to the 69° of north latitude in Finnland. In Germany it occurs rather frequent while on the Hungarian Plain it is rare, it may be considered here as a relict. It lives in lowland moors. In the Pleistocene it was more frequent in the Hungarian Plain than now. It is an oligotherm species.

Valvata piscinalis. O. F. MÜLLER. Its area include the most part of Europe to the 70° of north latitude, Siberia, Asia-Minor Transcaucasia. It lives on lowlands and hills, in the mountains it do not reach greater altitudes. He lives in clear still waters or slowly running waters with good oxygen supply and rich in vegetation. In the backwaters of Tisza and in the pits of the inundation area it founds somewhere optimale conditions. It is known already in the Pliocene. In the Pleistocene it was locally frequent. It is an eurytherm species.

Bithynia tentaculata L. Its area include Europe, Northwest-Africa, West-Asia to India, in Finnland pass by the polar circle. It lives on lowlands and hills, in the highlands it is rare, though in the Alpes it was found to 1600 m. It occurs in different still-waters and slow-running waters in clear waters and in waters contaminated with organic wastes equally. In the backwaters and pits of Tisza it found locally optimale circumstances. It was frequent already in the Pliocene. It is also frequent in the Pleistocene, though not so frequent, than now. It is eurytherm but rather thermophil.

Bithynia leachi SHEPPARD. Its area lies from North-Africa through Europe to Siberia and the river Amur, south-eastward to Cis- and Transcaucasia. Between it is missing on great districts e. g. in the Alpes. It reaches to the 61° north latitude in North-Europe. In our country it lives sporadically on the Hungarian Plain and on the hills and mountains too in smaller still-waters with good oxygen supply and abundant vegetation. It is more sensitive than the former species, it tolerate warm, cold and aridity to a lesser extent, outside water endures only 1—2 days, on direct sunlight shortly perishes. In the Pleistocene it occured more frequent than today. It is moderately oligotherm.

Stagnicola palustris O. F. MÜLLER. It is a holarctic species. It is distributed from Algiers, Krim and Iran northward through Europe in Scandinavia to 71° north latitude. It is found in Siberia and North-America too. In our country it is generally distributed, on the mountains only sporadically. It lives in the still-waters rich in oxygen and vegetation; it occurs in slow-running waters too. In point of wiew of chemistry of waters it is little exacting. It lives also in temporary waters, it can ramble about the humide soil in the shadow of the vegetation of the shores, therefore its mode of life may be considered nearly as amphibiotic. As fossile it occured

from the Pliocene. In the Pleistocene it was more frequent and variable then today. It is eurytherm, moderately oligotherm.

Galba truncatula O. F. MÜLLER. It is a holarctic species. It is distributed from North-Africa through Europe to Island and Scandinavia, in North-Asia and West Asia, in North-America from Alaska to Hudson Bay. In the Alpes it was found to 2600 m. It lives in the little still waters, in the greater lakes only near to the shore. It occurs in the brooks of mountains, also in the temporary still waters of the plains. His distribution in Hungarian Plain is at present sporadic, it was more frequent in the Pleistocene. It is an eurytherm, or according to its optimum moderately oligotherm species.

Radix peregra O. F. MÜLLER. It is indigenous from North-Africa, Siria, Armenia and Kashmir northward in Europe, North-Asia and partly in Middle-Asia too. It occurs in Island. In Scandinavia it reaches the 71° north latitude. By us it occurs all over the country. It lives in the still-waters of the lowland, in the brooks of mountains with cold water, in acidic and basic waters it was found also in a thermal water of 47° C. It is an amphibiotic species, outside the waters it rambles on humide rocks, mosses and on fallen leaves and parched grasses. It appeared already in the Pliocene, it was frequent in the Pleistocene. It is strongly eurytherm, according to its optimum it is considered by the author as a moderately oligotherm species.

Radix ovata DRAP. It is indigenous in Europe and North-Asia to Island and the most northern pols of Scandinavia. On the most southern parts of the Iberian and Balkan Peninsula it is missing. In the Alpes it was found to 2500 m. It is euryoecic. It occurs in smaller still-waters with rich vegetation but also in slow- and fast-running waters. It is moderately sensitive to the chemistry of waters and to wastes, excellently endures the fluctuation of temperature. But in contrast to the former two species it is sensitive to desiccation, it is not predisposed to amphibiotic mode of life. It is frequent in the Pleistocene, at present it is the most frequent aquatic snail of the Hungarian Plain.

Physa fontinalis L. It lives from the northern parts of South-Europe to the 63° latitude in Finnland and to the western parts of East-Europe. It is a species of lowlands, on the lower parts of the mountains it occurs already sporadically. It loves the clear still-waters with abundant vegetation. The organic wastes of the waters do not infuence it considerably. In the Pleistocene it was sporadically, at present it is much more frequent on the Hungarian Plain. It is moderately thermophil.

Aplexa hypnorum L. It is a holarctic species. It lives from the northern parts of South-Europe in Scandinavia to the 63° latitude, in North-Asia to the 73,5° latitude, in North-America from Alaska to the Hudson gulf and to the river Colorado. It loves the moors and small waters rich in vegetation, rather them with the acid character, it endures desiccation well, but it may not be considered as amphibiotic because it lives actively only in water. In South-Europe and in Hungary it occurs sporadically, in North-Germany it is much more frequent. By us it was more frequent in the Pleistocene than today. It is oligotherm.

Planorbis corneus L. It is indigenous from the northern parts of South-Europe and Asia Minor to the 64° latitude in Scandinavia and East-Europe and to the western parts of Asia. By us it is frequent in the greater still-waters of the lowlands and hills, in the mountains it reaches no greater hights. It is known from the Pliocene, in the Pleistocene it was already frequent. The exemplares from the Pleistocene are generally smaller, the present-day climate is more favourable for it. It is moderately thermophil.

Anisus (Tropidiscus) planorbis L. It is indigenous in Europe and West-Asia from Tunis, Sicilia and Asia Minor to the southern parts of Scotland and the 63° latitude in Scandinavia. It lives in the small waters, moors, backwaters with muddy bottom. On the mountains it is rarer, although it reaches in the Alpes to 1000 m. It appeared in the Pliocene, it was frequent in the Pleistocene. It is eurytherm. It is moderately thermophil.

Anisus (Tropidiscus) carinatus O. F. Müller. It lives on western parts of Europe from the northern parts of Iberia and Italy to Ireland, Scotland, in Finnland to the 63° latitude, in the Alpes to 1200 m. It lives in waters similar to the biotops of the former species but it is rarer. It appeared in the Pliocene, by us it is sporadically in the Pleistocene and today as well, it seems that it loves the oceanic climate.

Anisus (Spiralina) vortex L. It is indigenous in Europe and in the western parts of Asia, in Finnland to the polar circle, in East-Europe to Archangelsk, in Siberia to the river Jenissei. It lives in small waters and marshes with abundant vegetation, in soft and in hard waters too. It appeared already in the Pliocene, by us it is rather frequent in the Pleistocene. It is eurytherm.

Anisus septemgyratus E. A. Bielz. It is a species indigenous in East-Europe, it is distributed from the river Oka to Mecklenburg and the northern parts of the Balkan Peninsula. It loves the swampy still-waters. In our country it occurs sporadically on the lowland and mountains too. In the Pleistocene it was locally frequent, nowadays due to the lack of suitable waters it is rarer. It is moderately thermophil.

Anisus leucostoma Millet. It is a palaearctic species, it lives from Algiers and Transcaucasia to Island, in Sweden to 63° of north latitude, and to Middle-Siberia. In South-Europe it occurs sporadically. In Hungary it is rather a montane species, in lesser extent occurs on the hills, on the lowland it is rare. It loves the more or less cold small still-waters. It subsists in temporary waters too. It endures in an anabiotic state the hard frosts and dried up in the muds the drought of the summer. In our country in the Pleistocene it was much more frequent that today, the climate of the pleistocene was more favourable for it. It is eurytherm, oligotherm.

Anisus spirorbis L. It occurs from the northern parts of South-Europe and from the countries of the Caucasus to Island, in Finnland to the 64° of latitude, to Archangelsk. It occurs in the western parts of Siberia too. It loves the smaller still-waters, it is found in large numbers also in temporary waters. It endures well desiccation, the organic wastes of water the lack of oxygen, the alkalinity of the thickening of sodic waters. At present it is the most frequent aquatic snail of the Hungarian Plain, on the hills it is rarer and in the mountains much more rarer. It is nearly

Gyraulus albus O. F. MÜLLER. It is distributed through hole Europe, northward to the 70°. In the most southern parts of South-Europe it is absent. In Asia it occurs from Beludzhistan to Kamchatka and Japan. It occurs in North-America too. It lives in still-waters and slow-running waters with soft but also with rather hard water. It was found by the author in waters with abundant vegetation and in waters without vegetation, in waters with sandy and muddy bottom equally. By us it is rather frequent in the Hungarian Plain, in the mountains it is already rarer. In the Pleistocene it was rather frequent. It is eurytherm.

Gyraulus laevis ALDER. It is a holarctic species. It is distributed from the Madeira-Islands and Algiers to Island and to the 63° latitude in Finnland, to West-Siberia, Middle-Asia and the Caucasus. It lives also in North-America. Is is found in smaller ponds. Generally it is not a frequent species. In Hungary at present it is rare, while in the Pleistocene it was rather frequent. Therefore it may be considered as an oligotherm species. It appeared already in the Pliocene.

Gyraulus crista L. It is indigenous from the northern parts of South-Europe to the 65° in Scandinavia and to the middle of East-Europe. In the Alpes it was found to 1890 m. It lives in smaller or greater still-waters with abundant vegetation on *Lemna,* on reed-leaves and on other plants. By us on the Hungarian Plains it lives in large numbers on favourable places. On the mountains it is rarer. In the Pleistocene it was rather frequent. It is eurytherm.

Segmentina nitida O. F. MÜLLER. It occurs from the northern parts of South-Europe to the 61° in Sweden, to the western parts of East-Europe, to the Caucasus and in the Alpes to 600 m. It lives in different still-waters, here and there it occurs in large numbers also in small waters, often among *Lemna.* In the Hungarian Plain it is generally distributed, locally it occurs in large numbers. On the hills it is rare, on the mountains more sporadically. It lived already in the Pliocene. In the Pleistocene it was much more rare than today. It is moderately thermophil.

Pisidium cinereum ALDER. It is distributed from the most southern parts of Europe to the 70° in Lappland, to Transcaucasia and the river Amur, in the Alpes to 2200 m. It is an euryoecic species, it was found by the author in the small waters of the lowland and in the cold water of the mountain-brooks. In Hungary it is equally frequent in the lowland and in the mountains. It appeared already in the Pliocene, it is frequent in the Hungarian Pleistocene.

Pisidium personatum MALM. It was found from South-Europe to Scotland and Middle-Sweden. It occurs rather in mountains, its precise distribution still calls for cearing up. It lives in small waters, springs, brooks, small ponds with more or less cold water, in greater ponds below 15 m. In Hungary in the Pleistocene it was more frequent than today. It is oligotherm.

Pisidium obtusale C. PFEIFFER. It is indigenous in the northern and middle parts of Europe, Southwards of the Alpes it is already rare. The most southern places of occurences are in Bulgaria, France and Corsica. Single occurences in the USSR, Asia and Alasca are also known. It reaches

dismissed in the Alpes. In the Pleistocene it is rather frequent but rarer than today. The present warmer climate is more favourable for it. It is eurytherm, thermophil.

Bathyomphalus contortus L. It occurs from the northern parts of South-Europe and Transcaucasia to the Shetland-Islands, to the 69° in Scandinavia, in the Alpes to 1800 m, eastward to the river Amur. In Hungary it occurs sporadically in the lowland and mountains too. In Middle-Europe westward of us it is already frequent. Chemistry of the waters does not affect it. It occurs in several kinds of still waters and in slow-running waters with vegetation. By us in the Pleistocene it was more frequent than at present. It is moderately oligotherm.
the most northern parts of Scandinavia. It lives in the small still-waters of the lowlands and mountains, more rarely in ponds. In the Hungarian Plain it is rather frequent, in the Pleistocene, howewer, it was more frequent than today. It is moderately oligotherm.

Pisidium nitidum JENNYNS. It is distributed through the hole Europe, in Scandinavia to the 70°, through East-Europe to the river Ob and to the Lake Bajkal, in the Alpes to 2650 m. It is a rather nordic species, occurences southward the Alpes only disjunct. It lives rather in rivers and brooks but it is demonstrated in still-waters too. In Hungary there are few data about it and it seems in the sediments of Pleistocene rare. It is an oligotherm species.

Amphibiotic species

They live preferentially on shores where they obtain much humidity which is the very thing they need. Occassionally they are found also in water strictly speaking, howewer, they are terrestric animals living outside water. They are named amphibiotic by the author not because they are at home in water and land equally but because they live on the border of the water and land they need both of them.

Carychium minimum O. F. MÜLLER. The typical form, to which belongs the exemplares found in the boring, is frequent in the northern parts of Europe, in Scandinavia it passes by the polar circle, in the Alpes to 1800 m, it is distributed in the western part of East-Europe, In the Hungarian Plain it is yet frequent. Its southern subspecies *(tridentatum)* appears already in Germany, in Hungary it occurs sporadically, the center of its area is southward of the Alpes, it is indigenous on the coasts of North-Africa. It was found several times and in large numbers by the author on branches floating in still-waters, but they might be exemplares swept away from the shores. Author found it also in shallow water beeing full of fallen leaves. But this may be considered as a very humide terrestrical biotop. Generally it is found under stones and branches and among plants on humide shores, in humide environment it subsists also far-off water. Its occurrence itself as *fossilium* indicate only humide environment but from this it is not possible to conclude with certainty on water. It is eurytherm. In the Hungarian Pleistocene it was generally as frequent as today. It appeared already in the Pliocene.

Succinea putris L. It is distributed in Europe, in North- and West-Asia. It reaches the most northern parts of Europe while in the greatest part of South-Europe it lacks. It is found on lowlands, on hills and in the valleys of mountains. It lives on plants and bushes of shores, in groves of inundation area, on humide meadows, on open, temporary aride fields it is already in pejus. It occurs also adhering on plants standing out the water. It is sensitive to desiccation. It is today distributed on the Hungarian Plain too, but author found it in large numbers only in cool and humide environments. It appeared already in the Pliocene, in the Hungarian Pleistocene it is frequent. Strictly speaking it is a terrestric species. Its fossile presence, however, indicates water with certainty. Author found it never in such an environment in the vicinity of which permanent or at least temporary water was not present.

Succinea oblonga DRAP. It is distributed through hole Europe to the 67°, in the Alpes to 1600 m. In the south and in the north it is already rare. It lives on shores and humide fields. It endures better desiccation then the other *Succinea* species. On the Hungarian Plain it is frequent on the open fields, on the shores of temporary sodic waters, it goes through the aride periods, it lives also far-off the water in the humide fallen leaves of thickets and defended from desiccation and on similar places. On permanent aride places with open vegetation it lacks. It appeared already in the Pliocene. It is one of the most common snail of the Hungarian Pleistocene and on the suitable places of the Hungarian Plain it is common at present too. It loves the temperate climate, it is susceptible against great cold and great hot. In the north it reaches only in the oceanic climate af Norway, in Sweden it reaches only to 63,5°, in Finnland it lacks. Its presence in the sediments excludes open, aride fields, it indicates the environment of shores which may be covered with an open vegetation too or it indicates a bushy-grovy vegetation far-off water.

Succinea pfeifferi RM. It is indigenous in Europe over the polar circle too, in West- and North-Asia, in Northwest-Africa. In the Alpes it reaches to 2100 m. It lives on water plants somewhat over the surface of water, on plants floating on water, on living and dead plants of humide shores and on mosses. Author found it in large numbers on the grassy parts of the inundation area of the Tisza in the time of collecting already desiccated. It is known in the Pliocene too. On the Hungarian Plain it was frequent in the Pleistocene and it is frequent here also today. In water also this species does not sojourn protracted. Among our *Succinea* species this species demands the most humidity. It is sensitive against desiccation. Its presence in the sediments indicates water with just like certainty than the aquatic species.

Hygrophil ubiquist species

Generally they are species with great tolerance, in Hungary they occur in the lowland and in the mountains equally. Their demand for humidity is great, their thin and generally glassy shell provides no effective shelter from the direct sunshine. They live in the humide fallen leaves of the groves of

shores, under stones and under the rind of mouldy woods. Where they found the essential shadow and humidity they live also far-off water. Their occurence in large numbers indicates generally a grovy environment.

Cochlicopa lubrica O. F. MÜLLER. It is a holarctic species. It is indigenous from the northwestern parts of Africa, from Asia Minor and Iran northward to Island, to the 71° in Scandinavia further in North-Asia and North-America too. It is common in mountains and on hills, on the lowlands it is already rarer. Mostly it is found among plant debris where it participates in a little moisture. It lives in forests, fields, rocky places in fallen leaves, under barks and stones etc. The *var. exigua* has a smaller water-demand. It appeared already before the Pleistocene. It is frequent in the loess, on the Hungarian Plain in the Pleistocene it was much more frequent than at present. It is moderately oligotherm.

Vertigo pygmaea DRAP. It is found from the northern parts of South-Europe to the most northern parts of North-Europe. In the Alpes it occurs to 2000 m, but in the high mountains it is rare. It is frequent on the lowlands, on the hills and lower mountains. It lives on humide meadows, in forests among fallen leaves, in mosses, under barks and stones, among the roots of grasses. It appeared in the Pliocene. In the Pleistocene of the Hungarian Plain it was more frequent than at present. It is moderately oligotherm.

Vertigo antivertigo DRAP. It is distributed through hole Europe from the Pyrenees, Sicily and the southern parts of the Balkan-Peninsula to the polar circle in Scandinavia and to 1000 m in the Alpes. It occurs in Turkestan to the Caucasus, Armenia and North-Iran. It lives on humide meadows, on shores, in humide forests on grasses, among fallen leaves, on decaying woods. It is indigenous on the lowlands and on lower mountains. By us it is rather frequent. It demands more humidity and warm than the former species. In the Pleistocene it is rarer than the former species. In the Pleistocene of the Hungarian Plain it was more frequent than today.

Vertigo angustior JEFFREYS. It is distributed in the middle part of Europe on lowlands and low mountains from Portugal to the Caspean Sea and to the polar circle in Scandinavia and to 1000 m in the Alpes. It occurs part of South-Europe, in North-Scandinavia, Finnland, in the northern and southern parts of East-Europe. It lives on lowlands and in low mountains on meadows, bushes, in decidous forests among fallen leaves, mosses and plant debris. By us it occurs sporadically, it prefers the northern parts of the Hungarian Plain and lower parts of the mountains. Under the more cold and humide climate of Germany it has a much more suitable environment. In the Pleistocene of the Hungarian Plain it was much more rare than the species *pygmaea,* but it occured more frequent than at present. The climate of the Hungarian Plain is at present aride and warm for it, while in the Pleistocene the climate was here mostly aride and cold.

Truncatellina cylindrica FÉR. It is distributed from the northern parts of North-Africa, from Asia Minor and Transcaucasia to Scotland, to the 61° in Sweden, to Moscow in East-Europe, in the Alpes it passes 2000 m. It lives on aride, sunny, bushy slopes preferentially at the foots of limestones, under decaying plants, falled leaves, mosses and stones.

By us it is generally distributed on the Hungarian Plain and in the mountains. It adheres to the arider places because here it finds warm but it hides itself for avoiding desiccation, it rambles only during raining. It is moderately thermophil. It appeared already in the Pliocene. On the Hungarian Plain it is neither in the loess nor at present frequent.

Pupilla muscorum L. Its distribution is holarctic. It occurs from Northwest-Africa to Island, to Lappland, in Norway to the 70° in East-Europe to the White Sea. It occurs in Turkestan, North-Asia and North-America too. By us it lives on the lowlands and lower places of the mountains, on warmer places it reaches greater hights. In the Alpes it is found to 1500 m. It lives mostly arider, moderately humide fallen leaves, under decayed woods and stones, among the roots of grasses. It loves the moderate humidity and warm. In the Hungarian Plain it is frequent in the loess and at present equally. On aride places it avoids the direct sunshine.

Vallonia pulchella O. F. MÜLLER. It is distributed in Northwest-Africa, in Europe to the most northern parts of Scandinavia in the temperate zone of Asia and in North-America. In the Alpes it occurs to 1500 m. By us it is frequent on the lowland and in the mountains equally. It is found on moderately humide places, frequently among the roots of grasses, moreover among fallen leaves, plant-debris, under decayed woods and stones. On the Hungarian Plain it is frequent in the loess and also recently. It appeared already in the Pliocene.

Vallonia enniensis GREDLER. It is a species of South-Europe, it occurs in South-Germany, in Poland and in the southern parts of East-Europe. By us it is frequent on the Hungarian Plain, in Transdanubia it is somewhat rarer. According WAGNER it is a subspecies of the former species. Its demands for environmental factor is similar to that of the former species, it is, however, more thermophil. In the older Pleistocene-literature it is called with the name *costatella.* In the sediments of Pleistocene of the Hungarian Plain it is frequent, between it and the former species occur perfect transitions.

Vallonia costata O. F. MÜLLER. Its distribution and mode of life is similar to them of the species *pulchella,* but it is more obstinate, it reaches farther northward and higher in the mountains, its demand for humidity is lesser. It tolerates cold better than *pulchella* although it is more thermophil. This may be the cause its less frequent occurence in our Pleistocene sediments.

Punctum pygmaeum. DRAP. It is a holarctic species. It is distributed from Algiers and from the Caucasus, in Europe to the most northern parts of Scandinavia. It occurs in North-Asia and North-America too. It lives in forests, bushy meadows, on humide and shady places among fallen leaves, decayed woods, under stones, mosses, among the roots of grasses. It is frequent in the Carpates on the hills it is already rarer, on the Hungarian Plain it is much more rare. It appeared already in the Pliocene, in the loess it is frequent, in the loess of the Hungarian Plain it is much more frequent than recently. It is oligotherm.

Vitrea crystallina. O. F. MÜLLER. It is distributed from Northwest-Africa to the 66° in Norway, in East-Europe to Leningrad, Moscow, Kursk, Krim and to the Caucasus. It has a considerable demand

for humidity. It lives in forest, on grovy meadows, on shores, among fallen leaves, under decayed woods and stones, among reeds and other water-plants. It is distributed on lowlands and in mountains equally, in Hungary, however, it is rather an inhabitant of the mountains. It appeared in the Pliocene. On the Hungarian Plain it is much more frequent in the loess than recently. It is oligotherm.

Euconulus trochiformis MONT. It is distributed from Algiers to the most northern parts of Scandinavia, to Eastnorth-Asia, it occurs also in the greater parts of North-America. In the Alpes it reaches 2500 m. It lives in forests, humide meadows, on shores among fallen leaves, plant debris, under stones. Its distribution by us is much more in mountains than on the lowlands, on the Hungarian Plain it is much more frequent in the loess than recently. It is oligotherm.

Deroceras agreste L. It is distributed through hole Europe to North-Scandinavia, Island, South-Greenland, to Northwest-Africa to Middle- and North-Asia. It lives on humide meadows, in groves in forests, in gardens on the lowland and in mountains equally. It is a nocturnal animal. In the day-time it conceals itself among fallen leaves, plant debris, under stones and preferentially under greater woods. It is eurytherm. Its demand for humidity is great, it is more frequent in humide years.

Trichia hispida L. It is distributed through hole Europe, from the northern parts of South-Europe and from the Caucasus nearly to the polar circle in Norway. Northward the Alpes it is more frequent than southward them. In the Alpes it reaches to 1300 m. It occurs in groves, on meadows, on shores among leaves, under decayed woods and stones, in the shadow of weeds. It lives preferentially among nettles. It is the inhabitant of the soil, it does not ramble on trees and bushes. It lives on lowlands and mountains equally. It is resistant against cold, it rambles in mild winter-days too. It appeared already in the Pliocene. It is a characteristic snail of the loess. On the Hungarian Plain it is much more frequent in the loess than recently. It is oligotherm.

Inhabitants of the groves

They are found usually in forests and groves. In our country they live at present more often or exclusively in the mountains. Their ecological valence is smaller than that of the species of the former group, their demand on environmental factors is more unilateral.

Columella edentula DRAP. It is distributed from the northern parts of South-Europe to the 71 degree in Sweden and in North-Asia and North-America too. It lives in humide and with abundant vegetation covered spots of forests and groves, mostly on river-sides, often on plants. In our country it occurs in the mountains and in the northern districts of the lowland too. In the drill-hole the *subspecies columella*, a more oligotherm animal than the original form was found. In North-Scandinavia and in the high mountains of Europe (Pyrenees, Alpes, Carpates) above the border of the forests it lives between stones, in vegetal decay, in humid places. It is rather frequent in the loess of the Hungarian Plain. It is strongly oligotherm. In the Pleistocene it was an inhabitant of the cold steppe.

Pupilla sterri v. VOITH. It is a species of the Alpes and Carpates. It lives on the northern parts of the Balkan Peninsule, in the Transcaspicum, in Turkestan, in the Pindus mountains and in the Tien San muontains to North-China, on the colder points of limestone mounts mostly on the foot of rocks in vegetal decay. It requires more warmth and fewer humidity than the former species. At present it is a montane species, but from the loess of the Hungarian Plain it is long known. In the Pleistocene it is the inhabitant of the cold steppe.

Clausilia dubia DRAP. In our mountains it is widely distributed. It occurs in the Alpes to 2400 m, in the Carpates it is also frequent. It is distributed to Albania, England and Northeast-Poland, in Scandinavia to the 64 degree. It is found in forests under fallen leaves, plant debris, on mouldy woods, between stones. In the Pliocene it lived already. It is frequent in the loess of the Hungarian Plain. It is an oligotherm species. Its demand on humidity is considerable.

Goniodiscus ruderatus STUDER. It is indigenous in North-Eurasia and North-America. It occurs southward to the Pyrenees, to the southern foot of the Alpes, to the Krim and Transcaspia. In North-Norway it is one of the most frequent snail. In the mountains of our country it is already sporadic. It is found in the forests under the bark of mouldy blocks of wood, in the fallen leaves, under stones. It likes the woods, therefore it avoids the tundra and the woodless steppe. It avoids oceanic climate too. It is known from the Pliocene. On the Hungarian Plain it is found also in the loess. In the Pleistocene it is an animal of the cold, aride tree steppe.

Perpolita hammonis STRÖM. *(Zonitoides radiatulus* ALDER). It is a holarctic species, it is frequent in Middle- and North-Europe, in West-Europe it is already rarer, in South-Europe sporadic. It is distributed northward to the 70 degree. In Island, North-Asia and North-America it is also indigenous. Author collected it in forests, on humide woodless meadows, on aride mountain-sides with open vegetation in mouldy plant debris, in fallen leaves, among the roots of grasses. It lives both on the plains and in the mountains. In our country it is distributed sporadically in the mountains. In the loess it occurs more frequently than recently. It has an oligotherm character.

Fruticicola fruticum O. F. MÜLLER. It is distributed from the northern parts of South-Europe to the 68 degree in Scandinavia, in East-Europe to Leningrad, to the Krim and Caucasus and in North-Asia. HAZAY collected it in the Tatra also in 1793 m height. Author observed it in half-shady humide groves, on the fringe of forests, more frequently in deciduous forests than in coniferous ones, in places with an open and high vegetation e. g. among nettles, in the cooler, more vaporous and moisty climate of the mountains on aride places too. In our country it is at present much more a montane species than an inhabitant of the lowland. The reason for this is not of the higher temperature of the lowlands but its aride character. It appeared already in the Pleistocene, it occurs also in the loess. It is moderately oligotherm.

Trichia striolata STUDER. It is indigenous in Northwest-Europe, the northern parts of Middle-Europe and the Alpes. Few data are known

about its recent occurrences. In the deciduous forests of limestone mountains it is found on humide places, on river-sides with abundant vegetation, frequently on nettles. In South-Germany it is frequent too. It is known from the Pliocene, it occurs in the loess of the Hungarian Plain. It is oligotherm, it rambles often during mild winters.

Perforatella bidens CHEMN. It is an East-European species. It is distributed in the western parts of East-Europe, to the 60 degree in the north, in Middle-Europe first of all in the lower parts of the Carpates and to the river Száva and to France in the south. In the Tatra it was collected in 885 m height. In the southern parts of East-Europe it lacks already. In the vicinity of waters on strongly humide or even marshy places, especially in *Roboreta* and *Alneta* it is often found; sometimes on humide meadows too. On the Hungarian Plain it is known long ago in the moore of Bátorliget. It was considered here as a Pleistocene relic. Author collected it in mass on the mouth of the river Szamos (Sárkánykert). It lived already in the Pliocene, in the Pleistocene it is rather frequent. It is moderately oligotherm, it has a considerable demand on humidity.

Arianta arbustorum L. It is a Middle- and North-European species. It is distributed from the Pyrenees and the southern slopes of Alpes, from the South-Carpates to Island, to the 70 degree in Scandinavia and in the Alpes to 3000 m. It shows a preference for the deciduous groves in the vicinity of waters. Author collected it on cool meadows of the mountains and in the vicinity of brooks in *Piceeta* at 1000 m height. It occurs also above the zone of forests on river-sides between stones and plants. It is indigenous both the plains and in the mountains. In our country it is much more a montane species than a lowland inhabitant. The reason for this is in first line the aridity and the deficiency in forests of the Hungarian Plain. It is known from the Pliocene. It is frequent in the loess. It is an eurytherm, moderately oligotherm animal with considerable demand on humidity.

Thermophil species

They are species of southern origin with considerable demand on warmth. They live on warm and aride places. Being not xerophile animals, they rambles during warm rains, but they tolerate rather the prolonged aridity than the coolness of humide biotopes.

Abida frumentum DRAP. It is distributed from the Iberian Peninsule and the northern parts of the Balkan Peninsule to the Alpes, Carpates and to the middle parts of Germany. It is found on sunny and grassy slopes, on rocks, on stone-walls, under stones, but also in groves. In our country it is frequent on the Hungarian Plain and in Transdanubia, in the mountains it occurs only on lower points. On the plains of North-Germany it is already lacking. It appeared already in the Pliocene, in the loess it is locally frequent.

Imparietula (Chondrula) tridens O. F. MÜLLER. It is distributed from the Mediterraneum, Caucasus and Iran to Mecklenburg and Brandenburg, to Lithuania and in the middle parts of East-Europe. In the Alpes it occurs to 1000 m. In our country it is an inhabitant of the lowland

and the hills, on the higher points of the mountains it is rare. It lives on similar places as the former species but it occurs also on humide, shady places if the microclimate is sufficiently warm. It appeared already in the Pliocene and in the Pleistocene it is frequent. During aride periods it hides oneself sooner than the former species. Its demand on warmth is somewhat lesser, its demand on humidity a little larger than that of the former species.

Helicella hungarica Soós et H. WAGNER. It is indigenous in first line on the sand-steppes with straggling vegetation between the rivers Danube and Tisza. It occurs sporadically in Transdanubia and more sporadically in Transsylvania. *Helicella hungarica* was considered formerly as *Helicella striata*. This latter is indigenous in West-Europe and in the parts of Middle-Europe northward to Hungary. *Helicella hungarica* hides oneself during aride periods into the soil. Its demand on warmth is higher than that of the former species. In the Hungarian Pleistocene it is described from several places under the names *Helicella striata, costulata, nilssoniana.*

Helix pomatia L. It is indigenous in first line in Southeast- and Middle-Europe from the northern parts of Italy and the Balkan Peninsule to France, South-England, South-Sweden, Estonia, eastward to Kiev. In the Alpes it gets up to 1800 m. It lives in groves, bushy places which may be aride or humide but warm. It avoids both the direct sunshine and the interior of closed forests. In our country it is an animal of the plains and mountains, on the higher points of the mountains it occurs already sporadically. It is known from the Pliocene, in the Pleistocene it is rare.

Vallonia tenuilabris AL. BRAUN.

In the boring this is the only species which does not live at present in our country. According to EHRMANN it is known alive only in Siberia, East-Turkestan and North-China. In Europe it occurs in the Upper-Pliocene and in the Later-Pleistocene. Author has no observations on living exemplares, more detailed informations about the mode of life of the species were not found in the literature. In Hungary it may be considered undoubtedly as an oligotherm species.

(to be continued)